



## Review Article

## Review of research works done on *Tamra Bhasma* [Incinerated Copper] at Institute for Post-Graduate Teaching and Research in Ayurveda, Jamnagar

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### Abstract

The metal, *Tamra* though mentioned in Ayurveda with a wide range of therapeutic utilities; is attributed with *Ashta Maha Dosha*. Hence, one should be cautious while using *Tamra Bhasma*. Considering the significance of *Tamra* in therapeutics, many studies have been carried out at different centers of India. Aim of the present study was to compile such available research works done on *Tamra* in the Department of Rasa Shastra and Bhaishajya Kalpana (RS and BK), IPGT and RA, Jamnagar and provide brief information about pharmaceutical, analytical, and pharmacological studies. Total eleven studies on *Tamra Bhasma*, which revalidated the impact of classical guidelines, safety issues, and therapeutic utilities, were screened from PG Department of RS and BK, Institute for Post-Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar. All studies revealed that *Tamra Bhasma* is safe clinically, experimentally at Therapeutic Equivalent Dose (TED) levels as no toxic hazards were reported during the treatment period. In all aspects (pharmaceutical, pharmacological, and clinical) *Somanathi Tamra Bhasma* has proven to be better than *Tamra Bhasma*. The clinical efficacy of *Tamra Bhasma* has been evaluated in *Shvasa*, *Kasa*, *Yakrit Pliha Vriddhi*, *Grahani*, etc. conditions. Satisfactory responses with a decrease in the intensity of signs and symptoms were reported in all the studies. Though certain limitations were observed in these researches, the results can be considered as a lead for further well stratified studies covering larger population. No adverse effects were reported in any of these studies.

**Key words:** *Bhasma*, *Grahani*, *Rasa Shastra*, safety, *Somanathi Tamra*, *Tamra* toxicity

### Introduction

Since the prehistoric period, man has been using different sources of drugs for protection of health and treatment of diseases. These drugs in Ayurveda are obtained from natural sources such as plants, animals, and minerals. Use of metals and minerals in therapeutics has been found since Vedic period, which became an important part of Ayurvedic therapeutics due to their additional advantages like smaller doses, quick action etc.<sup>[1]</sup> *Bhasmas* are microfine powders of incinerated metals

and minerals that are therapeutically useful in different disease conditions since centuries without developing any noticeable side effects. Though these *Bhasmas* are being safely practiced in Indian scenario, concerns are being raised on safety issues in the recent past.<sup>[2]</sup> At the same time a number of studies have been conducted in different institutes of India, which provided safety aspects of *Bhasma*. Metals and minerals are the integral part of therapeutics in Ayurveda and *Tamra* (copper) is one of such metals, which, if properly processed and detoxified is useful in many diseases.<sup>[3]</sup> But if not processed properly, is dangerous to life.<sup>[4]</sup> It's toxic nature in improperly purified or incinerated state has been described as *Ashtamahadoshas* (eight blemishes) in Ayurvedic classics.<sup>[5]</sup> To make it fit for therapeutic use, *Tamra* has to pass through a set of classical pharmaceutical processes known as *Shodhana* (purification), *Marana* (incineration), and *Amritikarana*. *Tamra Bhasma* is useful in the treatment of *Udara* (ascitis), *Pandu* (anemia), *Shvasa* (bronchial asthma), and *Amlapitta* (hyperacidity), etc.<sup>[6]</sup>

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Considering the wide therapeutic utility of *Tamra Bhasma*, many research works have been carried out in the Department of Rasashastra and Bhaishajya Kalpana (RS and BK), Institute for Post-Graduate Teaching and Research in Ayurveda (IPGT and RA), Gujarat Ayurved University, Jamnagar with an intention to revalidate the classical principles of therapeutics.

The present study was to compile all available research works done on *Tamra* in the Department of RS and BK, and provide brief information about pharmaceutical, analytical, and pharmacological contributions.

## Materials and Methods

Works carried-out in the Department of RS and BK, IPGT and RA, Gujarat Ayurved University, Jamnagar at PhD and PG levels during 1964-2011 were compiled and screened to revalidate the classical concepts of drug preparation.

## Observations and Results

Initial studies carried out in 1964 evaluated clinical efficacy of *Tamra Bhasma*<sup>[7]</sup> in cases of *Shvasa* and *Amlapitta*.<sup>[8]</sup> The drug was administered at a dose of 65-125 mg. along with honey and other herbal powders such as *Guduchi* (*Tinospora cordifolia* Willd.), and *Amalaki* (*Phyllanthus embilica* Linn.). Encouraging results were obtained in this preliminary study.

Another study in 1965 evaluated clinical efficacy of *Tamra Bhasma*<sup>[9]</sup> and *Somnathi Tamra Bhasma*<sup>[10]</sup> (STB) on *Shvasa* (bronchial asthma), *Kasa* (cough), *Yakrit-Pliha Vridhhi* (hepato-splenomegaly).<sup>[11]</sup> *Tamra Bhasma* is reported to contain 37% Cu, while STB contains 24% Cu and traces of arsenic (80 ppm). *Tamra Bhasma* was administered in five clinically diagnosed cases of *Shvasa* for 30 consecutive days in a dose of 65 mg. along with *Talisadi churna* and *Madhu*. STB was administered for 30 consecutive days in six clinically diagnosed cases of *Shvasa* in a dose of 125 mg. along with *Pippali churna* and *Madhu*. Both the drugs were found to be significant in relieving the signs and symptoms of *Shvasa*. Both the drugs were also administered in cases of *Kaphaja Kasa* and *Yakrit Pliha Vridhhi* with promising results. On comparison of the clinical efficacy, STB was reported to have better results over *Tamra Bhasma*.

Pharmaceutical study of *Tamra Parpati*<sup>[12]</sup> and its clinical efficacy on *Yakrit Pliha Vridhhi* and *Grahani Roga* was evaluated in 1968.<sup>[13]</sup> *Tamra Parpati* was administered to the patients of *Yakrit Pliha Vridhhi* and *Grahani* in a dose of 65-250 mg twice a day with *Madhu* and other suitable adjuvants like *Takra* for 30 days. The size of the enlarged liver and spleen was found to be reduced up to 65% with the administration of *Tamra Parpati*. Relief was also reported by the patients of *Grahani*.

Role of *marana* media in the preparation of *Tamra Bhasma*<sup>[14]</sup> was studied during 1988.<sup>[15]</sup> *Bhasma* was prepared by using three different medias (*Parada*, *Gandhaka*, and *Kantakari*). *Gandhaka* (sulfur) was reported to be the simplest and precise media in securing safe media in preparing *Tamra Bhasma*. Difficulties were expressed by the researcher while preparing *Tamra Bhasma* in the presence of *Parada* media. It was also reported that, *Tamra Bhasma* prepared with *Parada* did not pass

the curd test<sup>[16]</sup> and hence remaining both groups were used clinically in *Tamaka Shvasa* at the dose of 125 mg thrice a day along with honey for 21 days. *Tamra Bhasma* showed significant results in *Tamaka Shvasa*. Total symptomatic relief observed by *Tamra Bhasma* of *Gandhaka* and *Kantakari* (*Solanum xanthocarpum*) media are 96.3% and 90.8% respectively. X-ray reports of chest posterior anterior view have shown good responses including reduction in thickening of broncho-vascular marking in both groups.

Studies in 1991<sup>[17]</sup> attempted on revalidating anti-asthmatic activity of *Dhattura Mulatvak Swarasa Bhavita Kajjali*, *Gandhaka Marita Tamra Bhasma*,<sup>[14]</sup> and *Mallasindura*.<sup>[18]</sup> Comparative study of these three *Yogas* was done on 56 known patients of *Tamaka Shvasa* for 21 days. *Tamra Bhasma* was given in the dose of 125 mg thrice a day along with honey. In this group, 86.16% and 87.22% relief in main and associated symptoms were found. An increase in peak expiratory flow rate was reported in *Tamra Bhasma* group. Breath holding time was well responded to *Dhattura Mulatvak Swarasa Bhavita Kajjali*. Maximum increase in chest expansion and hematopoietic action was found in *Mallasindura* group. From the overall effect of the three *Yogas*, it was concluded that *Tamra Bhasma* provided better results in pacifying the signs and symptoms of *Tamaka Shvasa*.

Experiments on *Tamra*, *Loha*, *Naga*, *Vanga*, and *Yashada Bhasmas* with respect to their media and to identify the composition and genuinity were carried out in 1991.<sup>[19]</sup> This study highlighted the importance of media used in the preparation of different *Bhasmas*. *Parada* media was used in preparation of *Tamra Bhasma*.<sup>[9]</sup> Classical parameters such as *Varna*, *Varitaratva*, *Rekhapurnatva*, and contemporary parameters such as chemical analysis, Namburi phased spot test, ICP-AES (Inductively Coupled Plasma Atomic Emission Spectroscopy) were used for evaluation of *Bhasmas*. On chemical analysis, acid insoluble ash 5.67% and 67.50% copper as Cu was found in *Tamra Bhasma*. Spectroscopy detected trace elements such as Ba, Cd, Hg, K, and Mg. Study revealed that *Bhasmas* prepared in different media having different compositions and thus show different chemical reactions.

Trial for pharmaceutical standardization of STB<sup>[10]</sup> was done in 2004.<sup>[20]</sup> Two samples of STB were prepared by *Kupipakva* method, one in *Valuka Yantra* and the other in electrical muffle furnace (EMF). EMF method was found more suitable than classical *Valuka Yantra* method considering the percentage yield of STB and other advantages of EMF. Manufacturing process of STB has been standardized in terms of time (total duration of 12 h) and temperature (*Mridu Agni* - 120-250°C, *Madhyama Agni* - 250-450°C, and *Tivra Agni* - 450-630°C). Analytically both samples of STB were found to contain Cu, As, S, and Fe. In addition, presence of Hg was reported (8.24%) in STB prepared in EMF while it was not found in the sample prepared in *Valuka Yantra*. This data reflects that, there is a difference in the chemical composition of both the samples prepared by different methods. Further, toxicity studies have been attempted in experimental animals. Chronic toxicity with five Therapeutic Equivalent Dose (TED) of both samples has shown mild degenerative changes in heart, kidney, liver, and spleen. Comparatively STB prepared in *Valuka Yantra* was reported to be safe in the study. Though the samples are

showing mild degenerative changes at five TED levels, they may be safe at TED levels.

Attempts to develop pharmaceutical profile and provide evidence about safety of *Tamra Bhasma*<sup>[21]</sup> and STB<sup>[10]</sup> on the basis of pharmacological grounds were done in 2005.<sup>[22]</sup> Pharmaceutically preparation of STB was found quite easier than *Tamra Bhasma*. Acute and chronic toxicities were studied in experimental animals. No mortality was reported in acute toxicity study even at 30 TED of *Tamra Bhasma* and STB. Chronic toxicity study with five TED has shown mild fatty degenerative changes in kidney, liver, and heart. However, these changes were observed only in kidney and heart with the treatment of STB. Both the drugs were used clinically in 12 patients of *Medoroga*. 30 mg of *Tamra Bhasma* twice a day with water for 21 days has shown a significant decrease in serum cholesterol and serum triglyceride levels. 75 mg of STB twice a day has found highly significant in decreasing serum triglyceride and high density lipoprotein level. This validated *Lekhana Karma* and lipid lowering capacity of STB. This activity was found significant in comparison to *Tamra Bhasma*.

Trial to develop standard manufacturing procedure of *Tamra Bhasma* by using *Rasa Bhasma* (*Kajjali*, *Rasa Sindura*, and *Rasa Parpati*) as media was done in 2006.<sup>[23]</sup> *Bhasma* was found to be cupric oxide in nature and associated with 30 other elements in different compound forms. In acute toxicity study, no exitus even at dose 16 TED was found, establishing the safety of the *Bhasma* at TED. Chronic toxicity studies (of 30 days duration) also established safety of *Bhasma* at five TED levels. Overall analysis of histopathological study indicates increased, though only modest, toxicity potential in *Tamra Bhasma* by *Rasa Sindura* media in comparison to other two groups. Clinically *Tamra Bhasma* prepared with *Kajjali* media was found better than *Tamra Bhasma* prepared with *Rasa Sindura* media in cases of *Sthaulya* (obesity).

Anti-hyperlipidemic and cardio-protective activity of *Tamra Bhasma*<sup>[21]</sup> and STB<sup>[10]</sup> in experimental models were evaluated in the studies of 2009.<sup>[24]</sup> *Tamra Bhasma* is identified as copper oxide (CuO); however, copper manganese oxide (CuMn<sub>2</sub>O<sub>4</sub>) was found in minor phase, whereas STB is reported to be a compound of copper, mercury, arsenic, and sulfur identified as aktashite (Cu<sub>6</sub>Hg<sub>3</sub>As<sub>3</sub>S<sub>6</sub>). Anti-hyperlipidemic activity and cardio-protective activities of STB were found significant in comparison to *Tamra Bhasma*. Significant decrease in serum triglyceride levels was reported with the treatment of *Tamra Bhasma*. The effect was statistically highly significant with STB in comparison to cholesterol control rats.

Trials on preparation of *Tamra Bhasma*<sup>[25]</sup> with *Kajjali* as media were done in 2011.<sup>[26]</sup> To evaluate the impact of *Shodhana* and establish safety, toxicity profile and anti-hyperlipidemic activity in experimental animals, *Tamra Bhasma* was prepared with *Shodhita* and *Ashodhita Tamra*. ICP-AES revealed that *Tamra Bhasma* prepared from *Shodhita Tamra* contained 56.42% copper and 23.06% sulfur while *Bhasma* prepared from *Ashodhita Tamra* (99.9% pure copper) had 44.91% copper and 45.35% sulfur. Traces of manganese, lead, arsenic, and zinc were found in both samples. Phase identification by X-ray diffraction revealed copper sulfate hydroxide [Cu<sub>4</sub>SO<sub>4</sub>(OH)<sub>6</sub>] and copper sulfide (CuS) in both samples of *Bhasma*, respectively. It was opined that, presence of hydroxide in *Shodhita Tamra Bhasma*

sample may be due to mishandling of the sample. *Tamra Bhasma*, which did not undergo *Shodhana* procedures, took more *Putas* for preparation of *Bhasma* indicating that *Shodhana* procedure helps in easy and early preparation of *Bhasma* by increasing brittleness of *Tamra* and reducing hardness and particle size. No mortality was observed in acute toxicity study with both the samples even at 180 TED levels. *Tamra Bhasma* prepared from *Shodhita Tamra* was reported to be safe in the sub-chronic study (of 45 days). In contrast, *Bhasma* prepared from *Ashodhita Tamra* was found to be toxic even at TED levels. *Bhasma* prepared from *Shodhita Tamra* has shown significant anti-hyperlipidemic activity which is almost absent in *Bhasma* prepared from *Ashodhita Tamra*. Exact reasons behind this profile need to be ascertained by adopting suitable analytical parameters. This study focuses on the role of *Shodhana* procedure in preparation of good *Tamra Bhasma*.

## Discussion

Metals are used in various disease conditions from Vedic period, but their use increased after development of *Rasashastra*, which is an integral part of *Ayurveda*. *Bhasma* of metals or minerals are one of the suitable pharmaceutical forms in *Rasashastra*. *Tamra Bhasma* is one among them. Though wide utility of *Tamra Bhasma* has been mentioned in *Rasa* classics, *Tamra* is said to be a poison or more than a poison if used in *Ashuddha* (impure) form. There is a need to revalidate these classical principles and develop safety profiles to generate evidences. In this course, a screening has been done through the works carried out in the Department of RS and BK, IPGT and RA, Gujarat Ayurved University, Jamnagar. Twelve studies have been carried out in the department. Initial study was done by Prof. HS Sharma under the guidance of Prof. Vasudeva Mulasankara Dwivedi in 1958. This work is familiarly known as “*Shulba Shastram*,” a compilatory work including comprehensive information on *Tamra* from the classics of *Rasashastra*. Remaining 11 works were compiled in the current attempt.

Out of the twelve, five each studies are based on pharmacological and clinical trials and one is based on analytical study.

## Pharmaceutical findings

Studies on evaluating the significance of *Tamra Shodhana* were reported that, more *Putas* are needed for the preparation of *Ashodhita Tamra Bhasma* in comparison to *Shodhita Tamra Bhasma*. Studies concluded that, *Shodhana* imparts increased brittleness, reduced hardness and particle size of *Tamra*.<sup>[25]</sup> Pharmaceutically, preparation of STB was found to be easier than preparation of *Tamra Bhasma*. Preparation of the product in EMF is reported to be convenient over *Valuka Yantra* posing to certain conveniences. *Kramagni Paka* for STB has been standardized in terms of time (of 12 h duration) and temperature (*Mridu Agni* – 120-250°C, *Madhyama Agni* – 250-450°C, and *Tivra Agni* – 450-630°C).<sup>[10]</sup>

## Analytical findings

Initial studies reported the nature of *Tamra Bhasma* as copper sulfide,<sup>[8]</sup> while the *Bhasma* prepared in the presence of *Rasa Bhasma* was found to be cupric oxide in nature associated with 30 other associated elements.<sup>[23]</sup> Other studies identified *Tamra Bhasma* as copper oxide (CuO) along with copper

manganese oxide ( $\text{CuMn}_2\text{O}_4$ ) in minor phases. STB was reported to contain Cu, As, S, and Hg and is identified as Aktashite ( $\text{Cu}_6\text{Hg}_5\text{As}_4\text{S}_6$ ).<sup>[22]</sup> AES-ICP revealed 56.42% copper and 23.06% sulfur in *Tamra Bhasma* prepared from *Shodhita Tamra* while *Bhasma* prepared from *Ashodhita Tamra* (99.9% pure copper) found to contain 44.91% copper and 45.35% sulfur. Traces of manganese, lead, arsenic, and zinc were found in both samples. Phase identification of *Tamra Bhasma* by X-ray diffraction revealed copper sulfate hydroxide [ $\text{Cu}_4\text{SO}_4(\text{OH})_6$ ] and copper sulfide (CuS) in both samples of *Bhasma*, respectively.<sup>[26]</sup> All these studies, reveal that *Bhasmas* prepared in different media have different compositions and show different chemical reactions. This gives an idea that specific clinical efficacy of a particular *Bhasma* incinerated in specific media may be due to its specific chemical composition and trace elements present in it.

### Pharmacological findings

No mortality with *Tamra Bhasma* was reported in acute toxicity at 30 TED<sup>[22]</sup> and 180 TED levels.<sup>[26]</sup> Sub-chronic toxicity studies evaluated the safety of *Tamra Bhasma* at five TED levels,<sup>[23]</sup> while chronic toxicity studies reported mild fatty degenerative changes in visceral organs with 5 TED. STB was reported to be safe, and no mortality was reported in acute toxicity at 30 TED.<sup>[22]</sup> Further studies attempted on evaluating the impact of *Shodhana* procedure. *Tamra Bhasma* prepared from *Shodhita Tamra* was reported to be safe in the sub-chronic study. In contrast, *Bhasma* prepared from *Ashodhita Tamra* was found to be toxic even at TED levels.<sup>[26]</sup> Significant anti-hyperlipidemic and cardio-protective activities of STB in comparison to *Tamra Bhasma* in experimental studies were reported.<sup>[22]</sup> Later studies also reported similar findings with *Tamra Bhasma* prepared from *Shodhita Tamra*, which was absent in *Bhasma* prepared with *Ashodhita Tamra*.<sup>[26]</sup>

### Clinical findings

Therapeutic efficacy of *Tamra Bhasma* has been validated in cases such as *Shvasa*, *Amlapitta*, *Kasa*, *Yakrit-Pliha Vriddhi*, and *Grahani Roga*. In all the studies, the *Bhasmas* were administered by mixing with suitable herbal powders and adjuvants. The therapeutic dose was ranging in between 65 and 250 mg. On comparison, the effect of STB is reported to be more significant than the *Tamra Bhasma*. No adverse effects were reported in any of the clinical studies.

### Conclusion

Metals and minerals are the integral parts of therapeutics in Ayurveda. *Tamra*, one of such metals been advocated in different forms in the management of various diseases. Classical texts emphasized on following classical guidelines (such as *Shodhana* and *Marana*) while preparing *Bhasmas* (incinerated powders) of the metals. This applies to *Tamra* too. Impact of *Shodhana* has been proven in studies which reported that *Ashodhita Tamra* poses inconvenience at pharmaceutical, pharmacological levels and proven to be toxic at TED level.

Analytically *Tamra Bhasma* is reported to be either sulfide or oxide of copper. The differences in chemical forms of incinerated copper reveal that *Bhasmas* prepared in different media have different compositions and show different chemical

reactions. Pharmacologically, mild degenerative changes in visceral organs were observed in acute, sub-chronic, and chronic toxicity studies at higher dose levels. It implies that properly prepared *Tamra Bhasma* is safe to be used under the supervision. The samples were proven to be potent anti-hyperlipidemic and cardio-protective agent.

The clinical efficacy of *Tamra Bhasma* has been studied in *Shvasa*, *Kasa*, *Yakrit Pliha Vriddhi*, *Grahani*, etc., The dose of *Tamra Bhasma* administered was ranging from 65 to 250 mg, and the duration was up to 45 days. The *Bhasma* was administered along with various suitable herbal powders and adjuvants like honey. Positive results with a decrease in the intensity of signs and symptoms were reported in all the studies. These studies were limited to a few number of cases, hence statistical significance did not draw. Since no adverse effects were reported in any of these studies, and satisfactory responses were noted by the patients; the results can be considered as a lead for further well stratified studies covering larger population. In all aspects, (pharmaceutical, pharmacological, and clinical) STB is reported to be better than *Tamra Bhasma*. All these studies prove that, the classical principles have their own scientific rationale and need to be followed mandatorily while processing in order to avoid the possibilities of unwanted effects.

### Acknowledgments

Authors duly acknowledge all the scholars and involved technical authority, whose works have been screened in the current attempt.

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## हिन्दी सारांश

### जामनगर के स्नातकोत्तर शिक्षण एवं अनुसंधान संस्थान में हुए ताम्र के कार्य की समीक्षा

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ताम्र भस्म की अनेकों चिकित्सीय उपयोगिताओं के वर्णन के साथ – साथ उसके अष्ट महादोषों का भी वर्णन आयुर्वेद में मिलता है। अतः प्रत्येक व्यक्ति को सावधानी पूर्वक ताम्र भस्म का उपयोग करना चाहिये। ताम्र की विभिन्न चिकित्सीय उपयोगिताओं को देखते हुए भारत की विभिन्न संस्थाओं में इस पर अध्ययन किया जा चुका है। आयुर्वेदिक स्नातकोत्तर शिक्षण एवं अनुसंधान संस्थान, जामनगर के रसशास्त्र एवं भेषज्यकल्पना विभाग में अब तक ताम्र पर हुए कार्यों के विवरणों का संयोजन करना तथा उनका औषध निर्माण, विश्लेषणात्मक और प्रयोगात्मक विषय में एक संक्षिप्त संसूचन उपलब्ध कराना इस अध्ययन का उद्देश्य है। इस अध्ययन में अब तक सम्पन्न ताम्र भस्म के समस्त ग्यारह अध्ययनों को शास्त्र वर्णित, सुरक्षात्मक प्रकाशन संबंधित एवं चिकित्सीय उपयोगिताओं को ध्यान में रखते हुए जांचा गया है। ताम्र भस्म की चिकित्सीय प्रभावकारिता श्वास, कास, यकृत-प्लीहा वृद्धि, ग्रहणी आदि में मूल्यांकित की जा चुकी है। सभी अध्ययन यही सिद्ध करते हैं कि ताम्र भस्म का चिकित्सीय मात्रा में सेवन करने से कोई भी हानिकारक प्रभाव उत्पन्न नहीं हुआ। चिकित्सा के सभी दृष्टिकोणों से सोमनाथी ताम्र भस्म, ताम्र भस्म की अपेक्षा अधिक प्रभावी सिद्ध हुआ है।